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(54) **RPDL protein and DNA encoding the same**

(57) The 5'-terminal partially nucleotide sequence of each clone of a human fetal lung cDNA library was determined. A clone having a novel sequence including a sequence homologous to that of the transcriptional control protein of a yeast was selected from among the above clones and its whole nucleotide structure was determined. It was confirmed that the protein encoded by the gene of the clone was a novel human transcriptional control protein (RPDL protein). Further, an expression vector for expressing the protein and a transformant obtained by transforming with such an expression vector can also be prepared.

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RTS-0140

## Description

## Background of the Invention

## 5 Field of the Invention

The present invention relates to an RPD<sub>L</sub> protein which is a novel transcriptional control protein, a process for producing this protein, a method of using the same, a DNA encoding the protein, and a gene analysis method using the DNA. The present invention finds applications in the pharmaceutical field.

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## Description of the Related Art

Many genes execute selective expression, for example, at a specific time or site or when a certain stimulus has been given. The expression of the genes involves two important steps consisting of producing a mRNA on the basis of  
15 information stored in the DNA sequence (transcription) and producing a protein by the action of the mRNA (translation).

It is becoming apparent in recent years that the transcription of genes in eukaryotic cells is skillfully controlled by a plurality of proteins known as transcriptional control proteins.

Analyzing in detail the mechanism of the above transcriptional control is a task extremely important from the view-  
point of learning the selective expression control mechanism of genes, namely, the cell differentiation or amplification  
20 or various gene activities and ultimately the fundamental system relating to, for example, life and death. It is expected that the analysis of the mechanism of the above transcriptional control would break through difficult problems of not only tumors but also other various diseases and abnormalities, and further aging, dementia, obesity, etc.

For the elucidation of the transcriptional control mechanism, it is essential to achieve "understanding the material  
bases of associated factors (transcriptional control protein, etc.)", "understanding the interaction between such factors",  
25 "understanding the whole process through a plurality of interactions", and "working out a systematic understanding through commonality and diversity" [see Masami Horikoshi et al, Tanpaku-shitsu • Kakusan • Koso (Protein, Nucleic Acid and Enzyme), Vol.38, No.5, p.p.831-841 (1993)].

Studies on structural fundamentals such that some basic transcription factors recognize specific sequences of the DNA and bind therewith have been advanced with the use of viruses, bacteria, yeasts, and the like. However, for example,  
30 the number of constituent factor groups is so large that elucidation is still being awaited in various fields such as the interaction between factors, the interaction of the factor with a component of transcription initiation complex, such as RNA polymerase, and the commonality in the control mechanism between viruses, bacteria, yeasts and human. Therefore, a marked progress of the analysis described above based on the recent gene isolations, especially, the cDNA clonings of factors associated with the human transcriptional control mechanism is being expected.

35 Known transcriptional control proteins include those specific for some genes and those commonly acting on a wide variety of genes. From the viewpoint of function, the known transcriptional control proteins include not only those capable of activating the transcription or inactivating the same but also those having both of the above capabilities [see M. Ptashne, Scientific American, Vol.260, p.p.40-47 (1989)].

Up to now studies on eukaryotic cells in this field have been conducted with the use of yeast as the model from the  
40 practical point of view, and it has been suggested that the fundamental mechanism thereof applies to human cells as well. The transcriptional control protein not only commonly acting on many genes but also having both the functions of activation and inactivation is considered as being especially important and, therefore, it is apparent that the studies on the effects exerted by its mutation with the use of yeast only have reached a limit.

Accordingly, isolating a human gene encoding the above important transcriptional control protein and identifying  
45 the protein has an extremely important significance in that a marked progress can be realized in the direct elucidation of the transcriptional control mechanism of the cells of multicellular organisms having such aspects as development, differentiation and tissue, especially, human per se.

## Disclosure of the Invention

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## Summary of the Invention

An object of the present invention is to provide an important human transcriptional control protein not only commonly  
acting on many target genes but also having both the functions of activation and inactivation, and a gene encoding the  
55 protein. Another object of the present invention is to provide a gene analysis method useful for elucidative studies on the mechanism of control of human gene transcription and on the effects on human cells caused by the mutation of the gene encoding the human transcriptional control protein with the use of the transcriptional control protein and DNA encoding the same.

The yeast transcription factor RPD3 controls not only the transcription of high- and low-affinity potassium transporter gene TRK2 but also the transcription of many genes including genes PHO5, STE6 and TY2 as the target. Further, it is known that the yeast PRD3 protein has both the functions of activation and inactivation [see M. Vidal and R.F. Gaber, Mol. Cel. Biol. Vol.11, p.p.6317-6327 (1991)].

5 The present inventors have determined the 5'-terminal nucleotide sequence of each clone derived from a cDNA library prepared from human fetal lung and have found a clone exhibiting homology with the sequence of the RPD3 gene of a yeast. Further, they have determined the DNA sequence of this clone and have obtained a full-length cDNA encoding a novel protein. It has been confirmed that the amino acid sequence of the protein encoded by this cDNA exhibits a significant similarity to that of the yeast RPD3 and this protein is a novel human transcriptional control protein that has  
10 never been reported.

Moreover, the present inventors have confirmed that the gene encoding this protein is an important gene which has expressed in all the studied human tissues excluding the brain by a gene analysis according to the Northern blotting technique using the above cDNA as a probe.

Furthermore, the present inventors have confirmed that the gene encoding this protein is localized at 1p34.1 on the  
15 short arm of the chromosome 1, the region where a deletion is recognized in mammary and gastric carcinomas, by the chromosomal mapping according to the FISH (fluorescent in situ hybridization) technique using the above cDNA as a probe.

The present invention has enabled not only the production of a transformant having, introduced thereinto, the cDNA encoding the above human transcriptional control protein or a DNA obtained by artificially mutating the same by intro-  
20 ducing the cDNA or the DNA into a host such as E. coli, yeast, an insect cell and a mammal cell, but also the production of the above protein or its variant with the use of the transformant and further the production of an antibody capable of binding with the above protein or its variant. Moreover, the present invention has enabled, on the level of human cells, not only the analyses of the interaction between the above protein and other factors capable of binding therewith, human genes controlled as the target and the activation and inactivation functions of the above protein as the transcriptional control factor, but also studies of the effects caused by the mutation of the DNA encoding the above protein.  
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Thus, the present invention provides an RPDL protein having an amino acid sequence, said amino acid sequence comprising the whole or a part of the amino acid sequence specified in sequence ID NO 1, or a variant of said RPDL protein. In the above explanation, "the variant of said RPDL protein" is one of RPDL proteins, has an amino acid sequence comprising the whole or a part of an amino acid sequence which is identical with the one specified in sequence ID NO  
30 1 except that one or more amino acids are added thereto, deleted therefrom or inserted thereinto, or that one or more amino acids are substituted for one or more amino acids contained in sequence ID NO 1, and acts in the same manner as that of said RPDL protein having an amino acid sequence comprising the whole or a part of the amino acid sequence specified in sequence ID NO 1.

Further, the present invention provides a DNA encoding said RPDL protein or a variant of said RPDL protein; a  
35 vector which contains a DNA encoding said RPDL protein or a variant of said RPDL protein; a transformant having, introduced thereinto, said vector; a process for producing said RPDL protein or a variant of said RPDL protein, which comprises culturing said transformant and recovering an expression product thereof; and a polyclonal antibody or a monoclonal antibody capable of combining with said RPDL protein or a variant of said RPDL protein.

Furthermore, the present invention provides a DNA probe having a DNA sequence, said DNA sequence comprising  
40 the whole or a part of the DNA sequence specified in sequence ID NO 2 or comprising a sequence complementary to the whole or a part of the DNA sequence specified in sequence ID NO 2; a DNA primer having a DNA sequence, said DNA sequence comprising a part of the DNA sequence specified in sequence ID NO 2 or comprising a sequence complementary to a part of the DNA sequence specified in sequence ID NO 2; and a gene analysis method for an RPDL protein characterized by hybridizing said DNA probe or said DNA primer with a subject DNA.

45 In other words, the present invention relates to (1) a protein comprising the whole or a part of the protein represented by sequence ID NO 1 or a variant thereof; (2) a DNA comprising the whole or a part of the DNA represented by sequence ID NO 2 or a mutant thereof, (3) a plasmid including the above DNA and a transformant carrying the same, (4) a process for producing the above protein, (5) an antibody capable of binding with the above protein, and (6) a probe or primer including a part of the above DNA sequence and a gene analysis method or gene amplification method characterized  
50 by using the same.

The present invention will be described in detail below.

#### Detailed Description of the Invention

##### 55 (1) Isolation of cDNA clone and confirmation of nucleotide sequence and amino acid sequence

cDNA was synthesized on the basis of mRNA derived from human fetal lung and a cDNA library containing cloned cDNA inserts in a given direction was prepared. The nucleotide sequence of each clone of this library was determined partially from the 5'-terminal side and one clone having a nucleotide sequence homologous with the RPD3 gene of a

yeast was obtained. Further, the whole nucleotide sequence of this clone was determined with the result that the desired full-length cDNA sequence was obtained.

The cDNA obtained by the above procedure was confirmed as having a novel DNA sequence represented by sequence ID NO 2 and the amino acid sequence of a novel protein encoded thereby was deduced as shown in sequence ID NO 1. The present inventors designated the protein having the sequence specified in sequence ID NO 1 as a RPDL protein, this designation being employed throughout this description.

The DNA of the present invention and a DNA complementary to said DNA can find applications in gene and gene expression analyses by the use of a part thereof as a primer or probe. The term "a part of the DNA" as used herein means a sequence of continuous at least six nucleotides, preferably at least eight nucleotides, still more preferably at least ten nucleotides, and most preferably 10 to 12 nucleotides or 15 to 25 nucleotides corresponding to (i.e., contained in or complementary to) the nucleotide sequence of the DNA according to the present invention. The primer or probe of the present invention which is an oligonucleotide or polynucleotide may contain also at least one nucleotide(s) not corresponding to the nucleotide sequence of the DNA encoding the RPDL protein.

The protein of the present invention can find applications in antibody preparation and agents for study and diagnosis containing such antibodies by the use of the whole or a part thereof as an epitope. The term "epitope" means an antigenic determinant of a polypeptide. It is well known that the epitope is generally composed of at least 5 amino acid residues and that a polypeptide composed of 6 amino acid residues combines with an antibody [see WO of PCT Patent Applications No. 8403564, published on Sep. 13, 1984 (Assignee: COMMONWEALTH SERUM LABS AND GEYSEN, H.M.)]. The term "a part of the protein" as used herein refers to a polypeptide comprising at least about 3 to 5 consecutive amino acid residues, preferably at least about 8 to 10 consecutive amino acid residues, and still more preferably at least about 11 to 20 consecutive amino acid residues on the basis of the amino acid sequence of the protein of the present invention. Needless to say, use can be made of even a polypeptide comprising at least about 20 amino acid residues. The polypeptide described above may contain also at least one amino acid residues not corresponding to the amino acid sequence of the RPDL protein.

The present invention comprehends RPDL proteins which are substantially equivalent to the RPDL protein having an amino acid sequence specified in sequence ID NO 1 and which are obtained by addition, deletion, insertion or substitution of one or more constituent amino acid residues of the above protein. Such equivalents are included in the present invention as long as they exert similar effects in the study and diagnosis regarding the RPDL protein. As in the protein above, DNAs which are substantially equivalent to the DNA encoding the RPDL protein having an amino acid sequence specified in sequence ID NO 1 and which are obtained by addition, deletion, insertion or substitution of one or more constituent nucleotides of the above DNA, i.e., equivalents, are also included in the present invention.

## (2) Recombinant expression vector and preparation of transformant and protein

A transformant can be obtained by inserting the DNA of the present invention or a part thereof into a suitable vector and transfecting this vector into suitable host cells. Human RPDL protein or a part thereof can be produced in a large quantity by culturing the transformant in the customary manner and separating from the resultant culture. More particularly, a recombinant expression vector can be prepared by religating the above DNA or a fragment thereof to a vector suitable for the expression downstream of the promoter according to the customary procedure in which a restriction enzyme and DNA ligase are employed. Examples of suitable vectors include plasmids pBR322 and pUC18 derived from *Escherichia coli*, plasmid pUB110 derived from *Bacillus subtilis*, plasmid pRB15 derived from yeast, bacteriophage vectors  $\lambda$ gt10 and  $\lambda$ gt11, and vector SV40. The vectors are not particularly limited as long as they can be replicated or amplified in the host. The promoter and terminator are also not particularly limited as long as they suit the host employed in the expression of the DNA sequence. Appropriate members thereof can be used in combination in accordance with the host. The DNA to be employed is not limited to the one having a DNA sequence specified in sequence ID NO 2. Use may be made of a DNA having a DNA sequence resulting from intentional or unintentional substitution, deletion, insertion and/or addition conducted individually or in combination at a part of the DNA sequence of sequence ID NO 2. Further, use may be made of one chemically synthesized.

The obtained recombinant expression vector is introduced into a host in accordance with any of the competent cell method [see J. Mol. Biol., Vol.53, p.154 (1970)], the protoplast method [see Proc. Natl. Acad. Sci. USA, Vol.75, p.1929 (1978)], the calcium phosphate method [see Science, Vol.221, p.551 (1983)], the in vitro packaging method [see Proc. Natl. Acad. Sci. USA, Vol.72, p.581 (1975)], the virus vector method [see Cell, Vol.37, p.1053 (1984)], etc., thereby preparing a transformant. Any of *Escherichia coli*, *Bacillus subtilis*, yeast, insect cells, animal cells and the like is used as the host. The obtained transformant is cultured in a medium suitable for the host. The culturing is generally conducted at 20 to 45°C and at pH of 5 to 8, in which aeration and agitation are executed according to necessity. The separation of the RPDL protein from the resultant culture and its purification may be conducted by an appropriate combination of conventional separation and purification methods. Examples of these conventional methods include salting out, solvent precipitation, dialysis, gel filtration, electrophoresis, ion exchange chromatography, affinity chromatography, and reversed-phase high-performance liquid chromatography.

## (3) Preparation of antibody

Antibodies can be prepared by the conventional method in which the whole or a part of the RPD<sub>L</sub> protein is used as an antigen. For example, a polyclonal antibody can be prepared by giving a plurality of subcutaneous, intramuscular, intraperitoneal or intravenous inoculations of the antigen to an animal such as a mouse, a guinea-pig and a rabbit thereby satisfactorily immunize the same, collecting the blood specimen from the animal, and performing serum separation. In this procedure, commercially available adjuvants can be used.

A monoclonal antibody can be prepared by, for example, conducting the fusion of splenocytes of a mouse immunized with the RPD<sub>L</sub> protein with commercially available mouse myeloma cells to thereby prepare a hybridoma and either culturing the hybridoma followed by separation of the antibody from the resultant supernatant or administering the hybridoma to a mouse followed by separation of the antibody from the mouse ascites.

The RPD<sub>L</sub> protein as an antigen does not necessarily have to possess the whole amino acid structure but use may be made of a peptide having a partial structure of the protein, a variant or derivative of the protein, or a fusion peptide resulting from the fusion with another peptide. The method for preparing these is not critical and it may be biological or chemosynthetic.

The obtained antibody enables the identification and quantity determination of RPD<sub>L</sub> protein in human biospecimens and can be used in, for example, various agents.

The immunoassay of RPD<sub>L</sub> protein may be conducted in accordance with the generally known procedure and can be executed by, for example, any of the fluorescent antibody technique, passive agglutination and enzyme antibody technique.

## (4) Analyses of mutation and abnormality of gene

Any mutation of a gene encoding the RPD<sub>L</sub> protein can be analyzed by the use of a probe comprising a restriction enzyme fragment of the DNA provided by the present invention or by the use of, as a primer, an oligonucleotide obtained by appropriately selecting a suitably positioned nucleotide sequence from the DNA and synthesizing therewith.

Also, any abnormality such as insertion and deletion in the gene of a specimen can be detected by the above analysis.

The *Escherichia coli* L1-3977 carrying the plasmid containing the DNA encoding the above RPD<sub>L</sub> protein was deposited with National Institute of Bioscience and Human-Technology, Agency of Industrial Science and Technology, Ministry of International Trade and Industry under the accession number FERM BP-4805 on September 21, 1994.

The use of a substance including the whole or a part of each of the human RPD<sub>L</sub> protein and the DNA encoding the protein according to the present invention has enabled analyses on the level of human cells not only of the functions of the above protein as a transcriptional control factor and the gene per se but also of the effects of any variation of the above protein. It is apparent that the protein of the present invention is an important transcriptional control protein commonly acting on many target genes and having both functions of activation and inactivation from the viewpoint of the homology of its amino acid sequence with that of the yeast RPD<sub>3</sub>. The contribution of the above investigations to the elucidation of the fundamental working of human cells, such as differentiation, amplification, activity and life and death thereof, is being anticipated. Moreover, the sequence structure of the above gene and its location on the chromosome have been defined, so that it can be anticipated that its relationships with not only tumors but also other various diseases and abnormalities of the gene are elucidated and its application is found in the pharmaceutical field.

## Examples

The present invention will be concretely described in detail with reference to the following Examples which in no way limit the scope of the invention.

## (Example 1) Preparation of human fetal lung cDNA library

cDNA was synthesized on the basis of mRNA derived from the human fetal lung (purchased from Clontech) and a cDNA library containing cloned cDNA inserts in a given direction was prepared by the use of UniZAPxR vector kit (purchased from Stratagene).

## (Example 2) Selection of clone

The nucleotide sequence of each of 2058 clones of the cDNA library prepared in Example 1 was partially determined from the 5'-terminal side. The resultant nucleotide sequences were compared with the known nucleotide sequences of a data base to find out one clone L1-3977 having homology with the yeast RPD<sub>3</sub>. A partial sequence (256 bp) of the clone L1-3977 exhibited a homology of 60.2% with the RPD<sub>3</sub> gene (Accession No. S66438, 1645 bp) of yeast (*Saccharomyces cerevisiae*) in the range of 176 bp.

## (Example 3) Sequencing of full-length cDNA and characteristics of structure

The DNA sequence of the clone LI-3977 obtained in Example 2 was determined by the Dideoxy method [see F. Sanger et al., Proc. Natl. Acad. Sci. USA, Vol.74, p.p.5463-5467 (1977)]. As a result, it was found that the clone LI-3977 contained a full-length cDNA having a novel sequence specified in sequence ID NO 2. The amino acid sequence of a novel protein (sequence ID NO 1, RPD3 protein) composed of 482 amino acid residues was deduced from an open reading frame formed of 64th to 1509th nucleotides of the above DNA sequence.

This amino acid sequence exhibited a homology of 60.0% with the RPD3 protein (Accession No. S22284 & P32561, 433 amino acid residues) of yeast (*S. cerevisiae*) in the range of 422 amino acid residues.

The nucleotide sequence of sequence ID NO 2 (2111 bp) exhibited a homology of 62.1% with the RPD3 gene (Accession No. S66438, 1645 bp) of yeast (*S. cerevisiae*) in the range of 1168 bp. Further, it exhibited a homology as high as 80.9% with the RPD3 homologue gene (Accession No. X78454, 1040 bp) of *Xenopus laevis* in the range of 1034 bp. A homology as high as 94.8% was recognized in the range of 343 amino acid residues between the protein (343 amino acid residues) encoded by the RPD3 homologue gene (Accession No. X78454, 1040 bp) of *Xenopus laevis* and the RPD3 protein of the present invention.

The above homology data demonstrate that the RPD3 protein of the present invention is an important human transcriptional control protein having the same functions as those of the RPD3 protein of a yeast. In addition, the nucleotide sequence (2111 bp) of sequence ID NO 2 has exhibited a homology as high as 78.9% with the nucleotide sequence of the 3'-noncoding region of proto-oncogene c-tk1 (chicken tyrosine kinase proto-oncogene) in a range as wide as 1534 bp, so that the importance of the RPD3 protein of the present invention in the transcriptional control mechanism has also been supported from the recent information on the association of the gene 3'-noncoding region with the control of transcription and translation.

## (Example 4) Analysis of expression in various human tissues

Expression analysis by Northern blot system (purchased from Clontech) was conducted with respect to various human tissue mRNAs with the use of the cDNA obtained in Example 3 as a probe. The conditions recommended by the manufacturer were obeyed on hybridization and washing, and autoradiography was conducted at -80°C for 16 hours. Actin was used as a control. As a result, expression was recognized in the form of a mRNA band having a size of about 2.4 kbp in all the studied tissues (heart, kidney, liver, lung, pancreas, placenta, skeletal muscle, large intestine, peripheral leukocyte, ovary, prostate, small intestine, spleen, testis, and thymus gland) except the brain. While expression scarcely occurred in the brain, relatively strong expression occurred in the heart, pancreas and testis and relatively weak expression in the kidney.

## (Example 5) Chromosome mapping of the gene

The cDNA obtained in Example 3 was used as a probe for investigating the location of the gene encoding the RPD3 protein of the present invention on the chromosome. That is, the location on the chromosome with which the above probe hybridized was determined by the FISH method [see Inazawa et al., Genomics, Vol.10, p.p.1075-1078 (1991)]. As a result, the location was identified as being at 1p34.1 on the short arm of the chromosome 1. This location was the one at which deletion was recognized in mammary carcinoma [see A. Borg et al., Genes Chromosome Cancer, Vol.5, p.p.311-320 (1992)] and gastric carcinoma [see T. Sano et al., Cancer Res., Vol.51, p.p.2926-2931 (1991)].

## (Example 6) Construction of recombinant RPD3 protein expression vector

A partial sequence including the protein coding region was amplified by the PCR with the use of the cDNA obtained in Example 3 as a template. BamHI and EcoRI cleavage sites were added to the 5'-terminus of one primer and the 5'-terminus of the other primer, respectively. The obtained amplification product was digested with BamHI and EcoRI. The resultant fragment was inserted into expression vector pGEX-2T (purchased from Pharmacia) preliminarily digested with BamHI and EcoRI, thereby constructing expression plasmid pGST-RPD3. *E. coli* DH5 $\alpha$  was transformed with the plasmid pGST-RPD3 and resulting transformants were selected based on the ampicillin resistance, thereby obtaining a transformant capable of expressing a fusion protein of glutathione-S-transferase and RPD3 protein.

## (Example 7) Expression of recombinant RPD3 protein and its purification

The transformant obtained in Example 6 was cultured, and a recombinant RPD3 fusion protein was extracted from the resultant culture and purified.

Specifically, the transformant was cultured by shaking the same in 100 ml of LB medium (1% peptone, 0.5% yeast extract and 1% NaCl) at 37°C overnight. The resultant liquid culture was diluted tenfold with LB medium preliminarily

heated to 37°C and the resulting dilution was further cultured at 37°C for 30 to 90 minutes, thereby obtaining a culture of logarithmic growth phase. Isopropyl  $\beta$ -D-thiogalactopyranoside was added to 1  $\ell$  of the culture so that the final concentration thereof was 1 mM, followed by culturing for 3 to 4 hours. The culture was centrifuged to thereby separate bacterial cells. 10 ml of a column buffer (150 mM NaCl, 16 mM Na<sub>2</sub>HPO<sub>4</sub>, 4mM NaH<sub>2</sub>PO<sub>4</sub>, pH 7.3) was added to bacterial cells transformed with the expression vector pGST-RPDL, followed by sonication. A soluble fraction of a supernatant resulting from the cell disruption was applied to a glutathione-Sepharose 4B column (purchased from Pharmacia). The column was washed with the column buffer and then elution was conducted with an eluent containing 5 mM reduced glutathione. The eluted fraction was analyzed and fractionated by SDS polyacrylamide electrophoresis. As a result, a fraction in which the desired GST fusion protein of about 80 kDa was detected as a main band was obtained from the

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transformant constructed with the plasmid pGST-RPDL

SEQUENCE LISTING

5 (1) GENERAL INFORMATION:

(i) APPLICANT:

(A) NAME: Cancer Institute

(B) STREET: 37-1, Kamiikebukuro 1-chome, Toshima-ku

(C) CITY: Tokyo

10 (E) COUNTRY: Japan

(F) POSTAL CODE (ZIP): none

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(B) STREET: 6-10, Koishikawa 4-chome, Bunkyo-ku

(C) CITY: Tokyo

15 (E) COUNTRY: Japan

(F) POSTAL CODE (ZIP): none

(ii) TITLE OF INVENTION: RPDL Protein and DNA encoding the same

(iii) NUMBER OF SEQUENCES: 2

(iv) COMPUTER READABLE FORM:

(A) MEDIUM TYPE: Floppy disk

(B) COMPUTER: IBM PC compatible

(C) OPERATING SYSTEM: PC-DOS/MS-DOS

(D) SOFTWARE: PatentIn Release #1.0, Version #1.30 (EPO)

20 (vi) PRIOR APPLICATION DATA:

(A) APPLICATION NUMBER: JP 6-227876

(B) FILING DATE: 22-SEP-1994

25 (2) INFORMATION FOR SEQ ID NO: 1:

(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 482 amino acids

(B) TYPE: amino acid

(C) STRANDEDNESS:

(D) TOPOLOGY: linear

30 (ii) MOLECULE TYPE: protein

35 (vi) ORIGINAL SOURCE:

(A) ORGANISM: Homo sapiens

(vii) IMMEDIATE SOURCE:

(A) LIBRARY: human fetal lung cDNA library

40 (xi) SEQUENCE DESCRIPTION: SEQ ID NO: 1:

Met Ala Gln Thr Gln Gly Thr Arg Arg Lys Val Cys Tyr Tyr Tyr Asp

1 5 10 15

Gly Asp Val Gly Asn Tyr Tyr Tyr Gly Gln Gly His Pro Met Lys Pro

20 25 30

His Arg Ile Arg Met Thr His Asn Leu Leu Leu Asn Tyr Gly Leu Tyr

35 40 45

Arg Lys Met Glu Ile Tyr Arg Pro His Lys Ala Asn Ala Glu Glu Met

50 55 60

Thr Lys Tyr His Ser Asp Asp Tyr Ile Lys Phe Leu Arg Ser Ile Arg

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5	Pro	Asp	Asn	Met	Ser	Glu	Tyr	Ser	Lys	Gln	Met	Gln	Arg	Phe	Asn	Val
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	Gly	Glu	Asp	Cys	Pro	Val	Phe	Asp	Gly	Leu	Phe	Glu	Phe	Cys	Gln	Leu
				100					105					110		
10	Ser	Thr	Gly	Gly	Ser	Val	Ala	Ser	Ala	Val	Lys	Leu	Asn	Lys	Gln	Gln
			115						120					125		
	Thr	Asp	Ile	Ala	Val	Asn	Trp	Ala	Gly	Gly	Leu	His	His	Ala	Lys	Lys
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	145					150					155					160
	Leu	Glu	Leu	Leu	Lys	Tyr	His	Gln	Arg	Val	Leu	Tyr	Ile	Asp	Ile	Asp
					165					170					175	
20	Ile	His	His	Gly	Asp	Gly	Val	Glu	Glu	Ala	Phe	Tyr	Thr	Thr	Asp	Arg
				180					185						190	
	Val	Met	Thr	Val	Ser	Phe	His	Lys	Tyr	Gly	Glu	Tyr	Phe	Pro	Gly	Thr
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	210					215						220				
	Asn	Tyr	Pro	Leu	Arg	Asp	Gly	Ile	Asp	Asp	Glu	Ser	Tyr	Glu	Ala	Ile
	225					230					235					240
	Phe	Lys	Pro	Val	Met	Ser	Lys	Val	Met	Glu	Met	Phe	Gln	Pro	Ser	Ala
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	305					310					315					320
40	Asp	Thr	Glu	Ile	Pro	Asn	Glu	Leu	Pro	Tyr	Asn	Asp	Tyr	Phe	Glu	Tyr
				325						330					335	
	Phe	Gly	Pro	Asp	Phe	Lys	Leu	His	Ile	Ser	Pro	Ser	Asn	Met	Thr	Asn
				340					345					350		
45	Gln	Asn	Thr	Asn	Glu	Tyr	Leu	Glu	Lys	Ile	Lys	Gln	Arg	Leu	Phe	Glu
			355					360					365			
	Asn	Leu	Arg	Met	Leu	Pro	His	Ala	Pro	Gly	Val	Gln	Met	Gln	Ala	Ile
		370					375					380				
50	Pro	Glu	Asp	Ala	Ile	Pro	Glu	Glu	Ser	Gly	Asp	Glu	Asp	Glu	Asp	Asp
	385					390					395					400
	Pro	Asp	Lys	Arg	Ile	Ser	Ile	Cys	Ser	Ser	Asp	Lys	Arg	Ile	Ala	Cys
				405					410					415		
55	Glu	Glu	Glu	Phe	Ser	Asp	Ser	Glu	Glu	Glu	Gly	Glu	Gly	Gly	Arg	Lys

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(11) MOLECULE TYPE: cDNA to mRNA

(vii) IMMEDIATE SOURCE:  
(A) LIBRARY: human fetal lung cDNA library

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GAGCGGAGCC GCGGGCGGGA GGGCGGACGG ACCGACTGAC GGTAGGGACG GGAGGCGAGC 60

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5	TTG TCT ACT GGT GGT TCT GTG GCA AGT GCT GTG AAA CTT AAT AAG CAG Leu Ser Thr Gly Gly Ser Val Ala Ser Ala Val Lys Leu Asn Lys Gln 115 120 125	444
10	CAG ACG GAC ATC GCT GTG AAT TGG GCT GGG GGC CTG CAC CAT GCA AAG Gln Thr Asp Ile Ala Val Asn Trp Ala Gly Gly Leu His His Ala Lys 130 135 140	492
15	AAG TCC GAG GCA TCT GGC TTC TGT TAC GTC AAT GAT ATC GTC TTG GCC Lys Ser Glu Ala Ser Gly Phe Cys Tyr Val Asn Asp Ile Val Leu Ala 145 150 155	540
20	ATC CTG GAA CTG CTA AAG TAT CAC CAG AGG GTG CTG TAC ATT GAC ATT Ile Leu Glu Leu Leu Lys Tyr His Gln Arg Val Leu Tyr Ile Asp Ile 160 165 170 175	588
25	GAT ATT CAC CAT GGT GAC GGC GTG GAA GAG GCC TTC TAC ACC ACG GAC Asp Ile His His Gly Asp Gly Val Glu Ala Phe Tyr Thr Thr Asp 180 185 190	636
30	CGG GTC ATG ACT GTG TCC TTT CAT AAG TAT GGA GAG TAC TTC CCA GGA Arg Val Met Thr Val Ser Phe His Lys Tyr Gly Glu Tyr Phe Pro Gly 195 200 205	684
35	ACT GGG GAC CTA CGG GAT ATC GGG GCT GGC AAA GGC AAG TAT TAT GCT Thr Gly Asp Leu Arg Asp Ile Gly Ala Gly Lys Gly Lys Tyr Tyr Ala 210 215 220	732
40	GTT AAC TAC CCG CTC CGA GAC GGG ATT GAT GAC GAG TCC TAT GAG GCC Val Asn Tyr Pro Leu Arg Asp Gly Ile Asp Asp Glu Ser Tyr Glu Ala 225 230 235	780
45	ATT TTC AAG CCG GTC ATG TCC AAA GTA ATG GAG ATG TTC CAG CCT AGT Ile Phe Lys Pro Val Met Ser Lys Val Met Glu Met Phe Gln Pro Ser 240 245 250 255	828
50	GCG GTG GTC TTA CAG TGT GGC TCA GAC TCC CTA TCT GGG GAT CGG TTA Ala Val Val Leu Gln Cys Gly Ser Asp Ser Leu Ser Gly Asp Arg Leu 260 265 270	876
55	GGT TGC TTC AAT CTA ACT ATC AAA GGA CAC GCC AAG TGT GTG GAA TTT Gly Cys Phe Asn Leu Thr Ile Lys Gly His Ala Lys Cys Val Glu Phe 275 280 285	924
60	GTC AAG AGC TTT AAC CTG CCT ATG CTG ATG CTG GGA GGC GGT GGT TAC Val Lys Ser Phe Asn Leu Pro Met Leu Met Leu Gly Gly Gly Tyr 290 295 300	972
65	ACC ATT CGT AAC GTT GCC CGG TGC AGG ACA TAT GAG ACA GCT GTG GCC Thr Ile Arg Asn Val Ala Arg Cys Arg Thr Tyr Glu Thr Ala Val Ala 305 310 315	1020
70	CTG GAT ACG GAG ATC CCT AAT GAG CTT CCA TAC AAT GAC TAC TTT GAA Leu Asp Thr Glu Ile Pro Asn Glu Leu Pro Tyr Asn Asp Tyr Phe Glu 320 325 330 335	1068
75	TAC TTT GGA CCA GAT TTC AAG CTC CAC ATC AGT CCT TCC AAT ATG ACT Tyr Phe Gly Pro Asp Phe Lys Leu His Ile Ser Pro Ser Asn Met Thr 340 345 350	1116
80	AAC CAG AAC ACG AAT GAG TAC CTG GAG AAG ATC AAA CAG CGA CTG TTT Asn Gln Asn Thr Asn Glu Tyr Leu Glu Lys Ile Lys Gln Arg Leu Phe 355 360 365	1164
85	GAG AAC CTT AGA ATG CTG CCG CAC GCA CCT GGG GTC CAA ATG CAG GCG	1212

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	Glu Asn Leu Arg Met Leu Pro His Ala Pro Gly Val Gln Met Gln Ala	
	370 375 380	
5	ATT CCT GAG GAC GCC ATC CCT GAG GAG AGT GGC GAT GAG GAC GAA GAC Ile Pro Glu Asp Ala Ile Pro Glu Glu Ser Gly Asp Glu Asp Glu Asp	1260
	385 390 395	
10	GAC CCT GAC AAG CGC ATC TCG ATC TGC TCC TCT GAC AAA CGA ATT GCC Asp Pro Asp Lys Arg Ile Ser Ile Cys Ser Ser Asp Lys Arg Ile Ala	1308
	400 405 410 415	
	TGT GAG GAA GAG TTC TCC GAT TCT GAA GAG GAG GGA GAG GGG GGC CGC Cys Glu Glu Glu Phe Ser Asp Ser Glu Glu Glu Gly Glu Gly Gly Arg	1356
15	420 425 430	
	AAG AAC TCT TCC AAC TTC AAA AAA GCC AAG AGA GTC AAA ACA GAG GAT Lys Asn Ser Ser Asn Phe Lys Lys Ala Lys Arg Val Lys Thr Glu Asp	1404
	435 440 445	
20	GAA AAA GAG AAA GAC CCA GAG GAG AAG AAA GAA GTC ACC GAA GAG GAG Glu Lys Glu Lys Asp Pro Glu Glu Lys Lys Glu Val Thr Glu Glu Glu	1452
	450 455 460	
	AAA ACC AAG GAG GAG AAG CCA GAA GCC AAA GGG GTC AAG GAG GAG GTC Lys Thr Lys Glu Glu Lys Pro Glu Ala Lys Gly Val Lys Glu Glu Val	1500
25	465 470 475	
	AAG TTG GCC TGA ATGGACCTCT CCAGCTCTGG CTTCCTGCTG AGTCCCTCAC Lys Leu Ala	1552
30	480	
	GTTTCTTCCC CAACCCCTCA GATTTTATAT TTTCTATTTC TCTGTGTATT TATATAAAAA	1612
	TTTATTAAAT ATAAATATCC CCAGGGACAG AAACCAAGGC CCCGAGCTCA GGGCAGCTGT	1672
35	GCTGGGTGAG CTCTTCCAGG AGCCACCTTG CCACCCATTC TTCCCGTTCT TAACTTTGAA	1732
	CCATAAAGGG TGCCAGGTCT GGGTGAAAGG GATACTTTTA TGCAACCATA AGACAAACTC	1792
	CTGAAATGCC AAGTGCCTGC TTAGTAGCTT TGGAAGGTG CCCTTATTGA ACATTCTAGA	1852
40	AGGGGTGGCT GGGTCTTCAA GGATCTCCTG TTTTTTTCAG GCTCCTAAAG TAACATCAGC	1912
	CATTTTTAGA TTGGTTCTGT TTTCGTACCT TCCCACTGGC CTCAAGTGAG CCAAGAAACA	1972
	CTGCCTGCCC TCTGCTGTGC TTCTCCTAAT TCTGCAGGTG GAGGTTGCTA GTCTAGTTTC	2032
45	CTTTTTGAGA TACTATTTTC ATTTTTGTGA GCCTCTTGT AATAAAATGG TACATTCTA	2092
	AAAAAAAAA AAAAAAAAAA	2111

## Claims

1. An RPD L protein having an amino acid sequence, said amino acid sequence comprising the whole or a part of the amino acid sequence specified in sequence ID NO 1.
2. An RPD L protein having an amino acid sequence, said amino acid sequence comprising the whole or a part of an amino acid sequence which is identical with the one specified in sequence ID NO 1 except that one or more amino

acids are added thereto, deleted therefrom or inserted therein, or that one or more amino acids are substituted for one or more amino acids contained in sequence ID NO 1.

- 5 3. A DNA encoding an RPDL protein having an amino acid sequence, said amino acid sequence comprising the whole or a part of the amino acid sequence specified in sequence ID NO 1.
4. The DNA encoding an RPDL protein as claimed in claim 3, which has the DNA sequence specified in sequence ID NO 2.
- 10 5. A DNA encoding an RPDL protein having an amino acid sequence, said amino acid sequence comprising the whole or a part of an amino acid sequence which is identical with the one specified in sequence ID NO 1 except that one or more amino acids are added thereto, deleted therefrom or inserted therein, or that one or more amino acids are substituted for one or more amino acids contained in sequence ID NO 1.
- 15 6. A vector which contains a DNA encoding an RPDL protein having an amino acid sequence, said amino acid sequence comprising the whole or a part of the amino acid sequence specified in sequence ID NO 1.
7. A vector which contains a DNA encoding an RPDL protein having an amino acid sequence, said amino acid sequence comprising the whole or a part of an amino acid sequence which is identical with the one specified in  
20 sequence ID NO 1 except that one or more amino acids are added thereto, deleted therefrom or inserted therein, or that one or more amino acids are substituted for one or more amino acids contained in sequence ID NO 1.
8. A transformant having, introduced therein, a vector, said vector containing a DNA encoding an RPDL protein, said RPDL protein having an amino acid sequence comprising the whole or a part of the amino acid sequence specified  
25 in sequence ID NO 1.
9. A transformant having, introduced therein, a vector, said vector containing a DNA encoding an RPDL protein, said RPDL protein having an amino acid sequence comprising the whole or a part of an amino acid sequence which is identical with the one specified in sequence ID NO 1 except that one or more amino acids are added thereto, deleted  
30 therefrom or inserted therein, or that one or more amino acids are substituted for one or more amino acids contained in sequence ID NO 1.
10. A process for producing an RPDL protein having an amino acid sequence comprising the whole or a part of the amino acid sequence specified in sequence ID NO 1, which comprises culturing a transformant having, introduced  
35 therein, a vector containing a DNA encoding the RPDL protein, and recovering an expression product thereof.
11. A process for producing an RPDL protein having an amino acid sequence comprising the whole or a part of an amino acid sequence which is identical with the one specified in sequence ID NO 1 except that one or more amino acids are added thereto, deleted therefrom or inserted therein, or that one or more amino acids are substituted  
40 for one or more amino acids contained in sequence ID NO 1, which comprises culturing a transformant having, introduced therein, a vector containing a DNA encoding the PRLTS protein, and recovering an expression product thereof.
12. A polyclonal antibody or a monoclonal antibody capable of combining with an RPDL protein having an amino acid sequence, said amino acid sequence comprising the whole or a part of the amino acid sequence specified in  
45 sequence ID NO 1.
13. A polyclonal antibody or a monoclonal antibody capable of combining with an RPDL protein having an amino acid sequence, said amino acid sequence comprising the whole or a part of an amino acid sequence which is identical  
50 with the one specified in sequence ID NO 1 except that one or more amino acids are added thereto, deleted therefrom or inserted therein, or that one or more amino acids are substituted for one or more amino acids contained in sequence ID NO 1.
14. A DNA probe having a DNA sequence, said DNA sequence comprising the whole or a part of the DNA sequence  
55 specified in sequence ID NO 2.
15. The DNA probe as claimed in claim 14, wherein the part of the DNA sequence is composed of at least 10 consecutive DNA units.

16. A DNA probe having a DNA sequence, said DNA sequence comprising a sequence complementary to the whole or a part of the DNA sequence specified in sequence ID NO 2.
- 5 17. The DNA probe as claimed in claim 16, wherein the part of the DNA sequence is composed of at least 10 consecutive DNA units.
18. A DNA primer having a DNA sequence, said DNA sequence comprising a part of the DNA sequence specified in sequence ID NO 2.
- 10 19. The DNA primer as claimed in claim 18, wherein the part of the DNA sequence is composed of at least 10 consecutive DNA units.
20. A DNA primer having a DNA sequence, said DNA sequence comprising a sequence complementary to a part of the DNA sequence specified in sequence ID NO 2.
- 15 21. The DNA primer as claimed in claim 20, wherein the part of the DNA sequence is composed of at least 10 consecutive DNA units.
- 20 22. A gene analysis method for an RPD L protein characterized by hybridizing a DNA probe with a subject DNA, wherein said DNA probe has a DNA sequence comprising the whole or a part of the DNA sequence specified in sequence ID NO 2.
- 25 23. A gene analysis method for an RPD L protein characterized by hybridizing a DNA probe with a subject DNA, wherein said DNA probe has a DNA sequence comprising a sequence complementary to the whole or a part of the DNA sequence specified in sequence ID NO 2.
24. A gene analysis method for an RPD L protein characterized by hybridizing a DNA primer with a subject DNA, wherein said DNA primer has a DNA sequence comprising a part of the DNA sequence specified in sequence ID NO 2.
- 30 25. A gene analysis method for an RPD L protein characterized by hybridizing a DNA primer with a subject DNA, wherein said DNA primer has a DNA sequence comprising a sequence complementary to a part of the DNA sequence specified in sequence ID NO 2.

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European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 95 11 4884

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,X	MOL. CELL. BIOL., vol. 11, no. 12, December 1991 pages 6317-6327, VIDAL. M. & GABER, R.F. 'RPD3 encodes a second factor required to achieve maximum positive and negative transcriptional states in <i>Saccharomyces cerevisiae</i> ' * fig. 4 *	1-3,5	C07K14/47 C07K16/18 C12Q1/68 C12N15/72
P,X	GENOMICS, vol. 24, no. 2, 15 November 1994 pages 276-279, SUDO, K. ET AL. '2058 expressed sequence tags (ESTs) from a human fetal lung cDNA library' * whole disclosure *	1-5	
X	& DDBJ database entry HSL13977, accession number D31480, submitted 01-05-1994; SUDO, K. et al.  * abstract *	1-5	
X	EMBL database entry Xlab 21, accession number X78454, submitted 25-03-1994; LADOMERY, M.R. et al. "yeast RPD3 homologue from <i>X. laevis</i> " * abstract *	1-3,5	TECHNICAL FIELDS SEARCHED (Int.Cl.6) C07K C12N C12Q
D,A	SCIENTIFIC AMERICAN, vol. 260, June 1989 pages 40-47, HOLLIDAY, R. 'A different kind of inheritance'		
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 18 January 1996	Examiner Hermann, R
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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